(12) UK Patent Application (19) GB (11) 2 308 264 (13) A

(43) Date of A Publication 18.06.1997

(21) Application No 9625687.0

(22) Date of Filing 11.12.1996

(30) Priority Data
(31) 95048431 (32) 11.12.1995 (33) KR

(51) INT CL[6]
H04N 5/783 5/781

(52) UK CL (Edition O )
H4F FD12M FD24 FD3P FD3T FKA

(56) Documents Cited
None

(58) Field of Search
UK CL (Edition O ) H4F FEHX FKA
INT CL[6] H04N 5/76 5/781 5/783 5/915 5/926
Online: WPI,INSPEC

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(54) **MPEG video disk recording system for high-speed reproduction**

(57) A disk for high-speed reproduction contains position information of successive I-pictures in a recording area of a present I-picture. Using the above disk, a predetermined waiting time is set in a timer based on a selected multiple speed when moving image data is reproduced at high speed. Referring to the position information of the I-pictures read from the disk, a pickup is moved to the position of the following I-picture to then be reproduced. The data is reproduced at the moved position if the waiting time given by the timer is reached. A larger amount of image information is used within a given time according to each selected multiple speed in order to realize a high-speed reproduction operation with a more natural image displayed.

FIG. 4

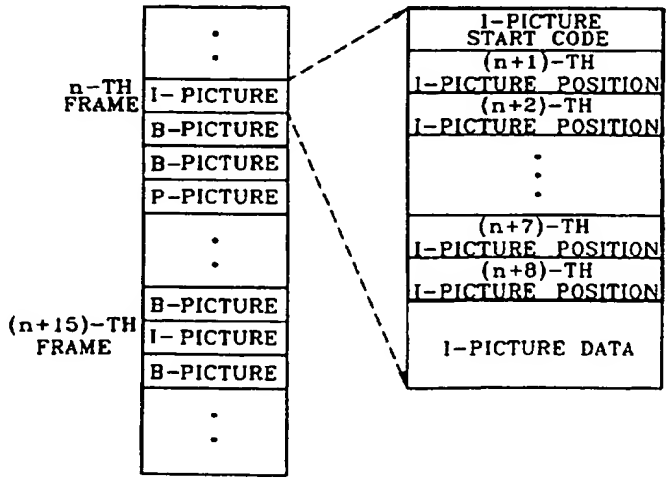


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FIG. 1A

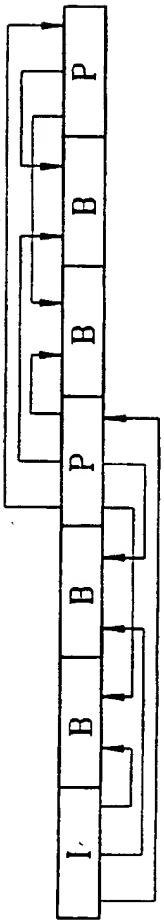


FIG. 1B

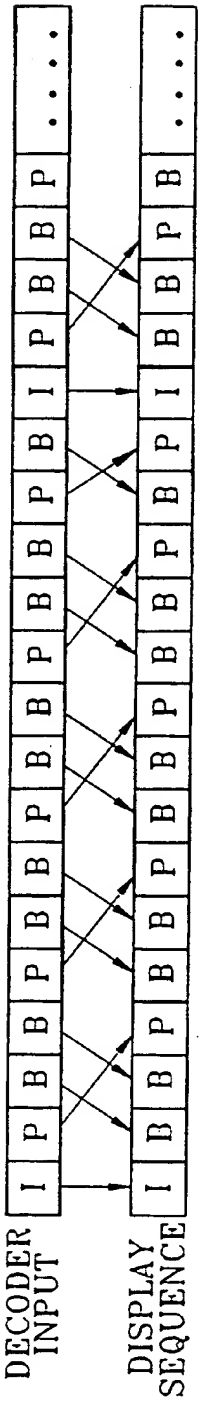

FIG. 2(PRIOR ART)

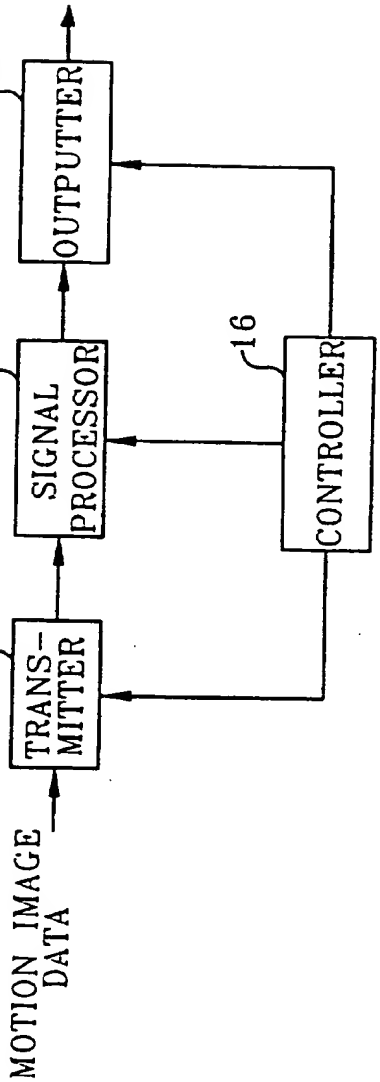

FIG. 3(PRIOR ART)

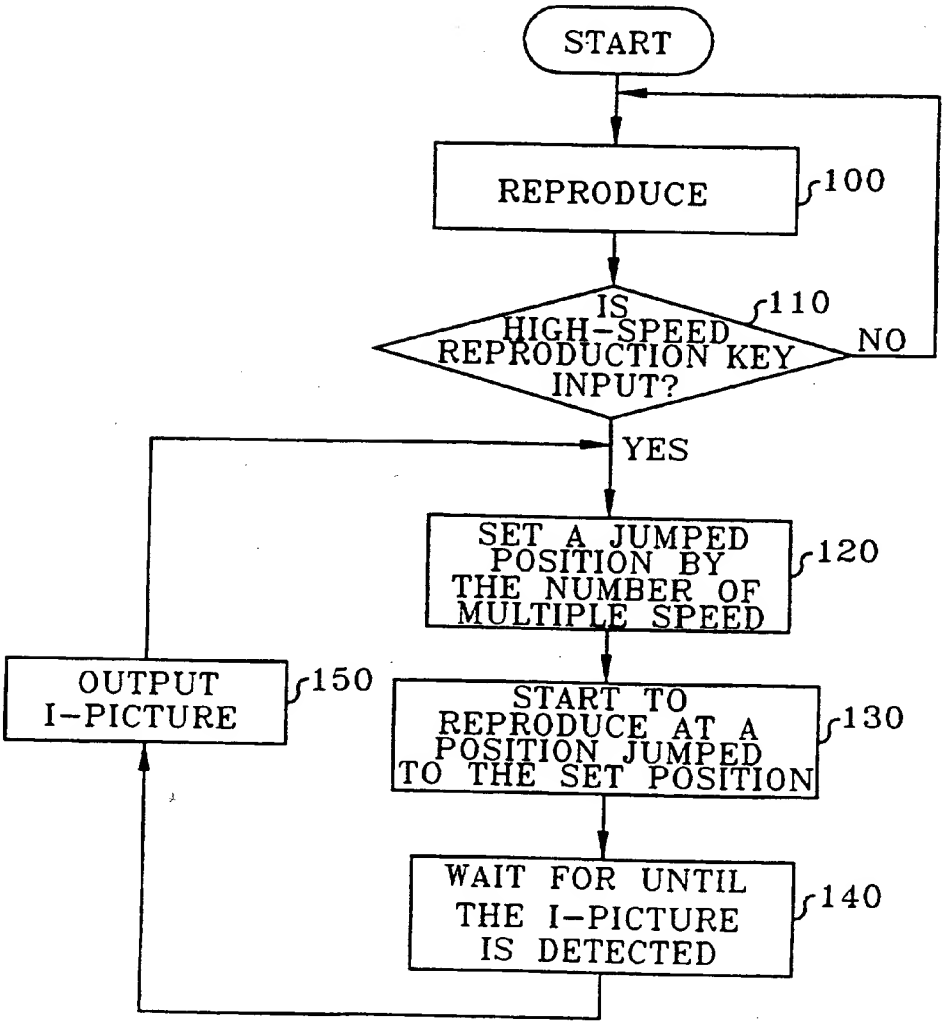

FIG. 4

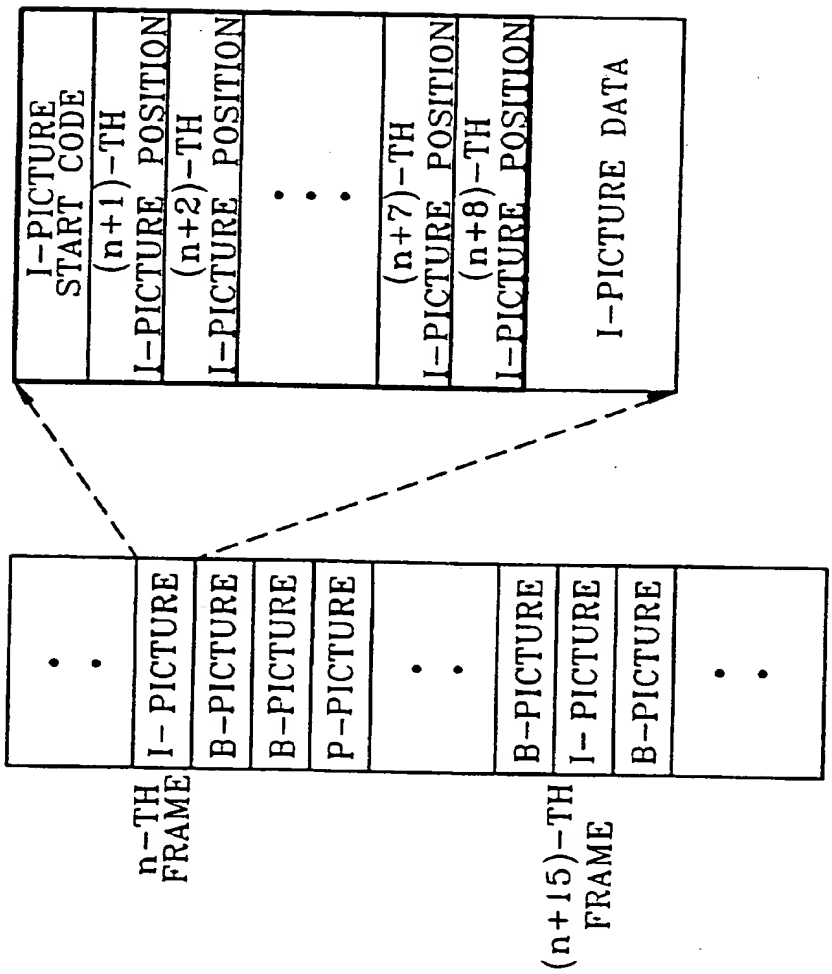

FIG. 5

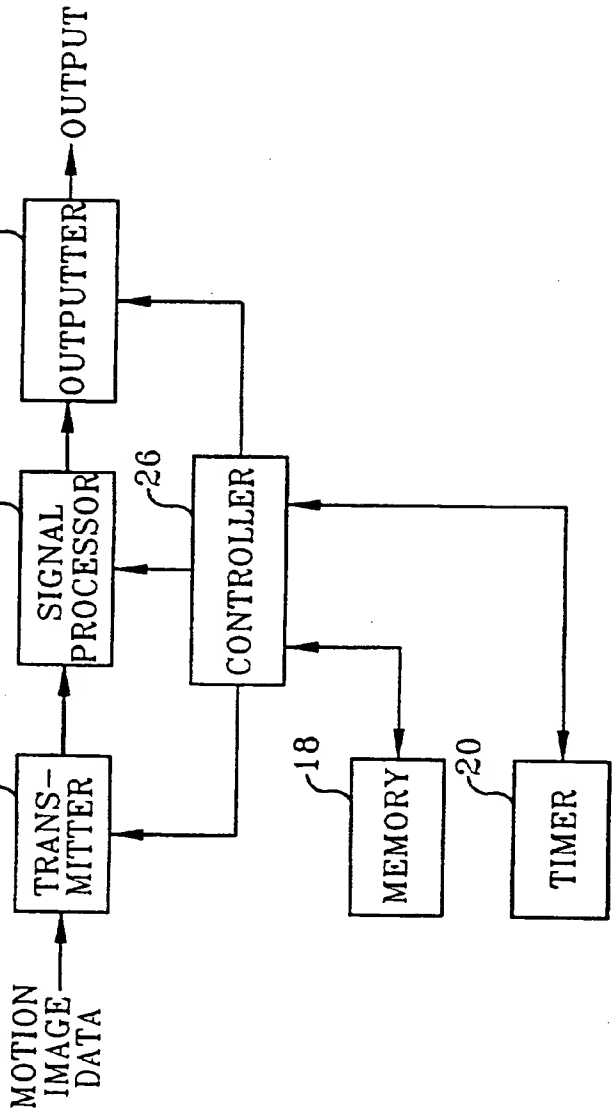

FIG. 6

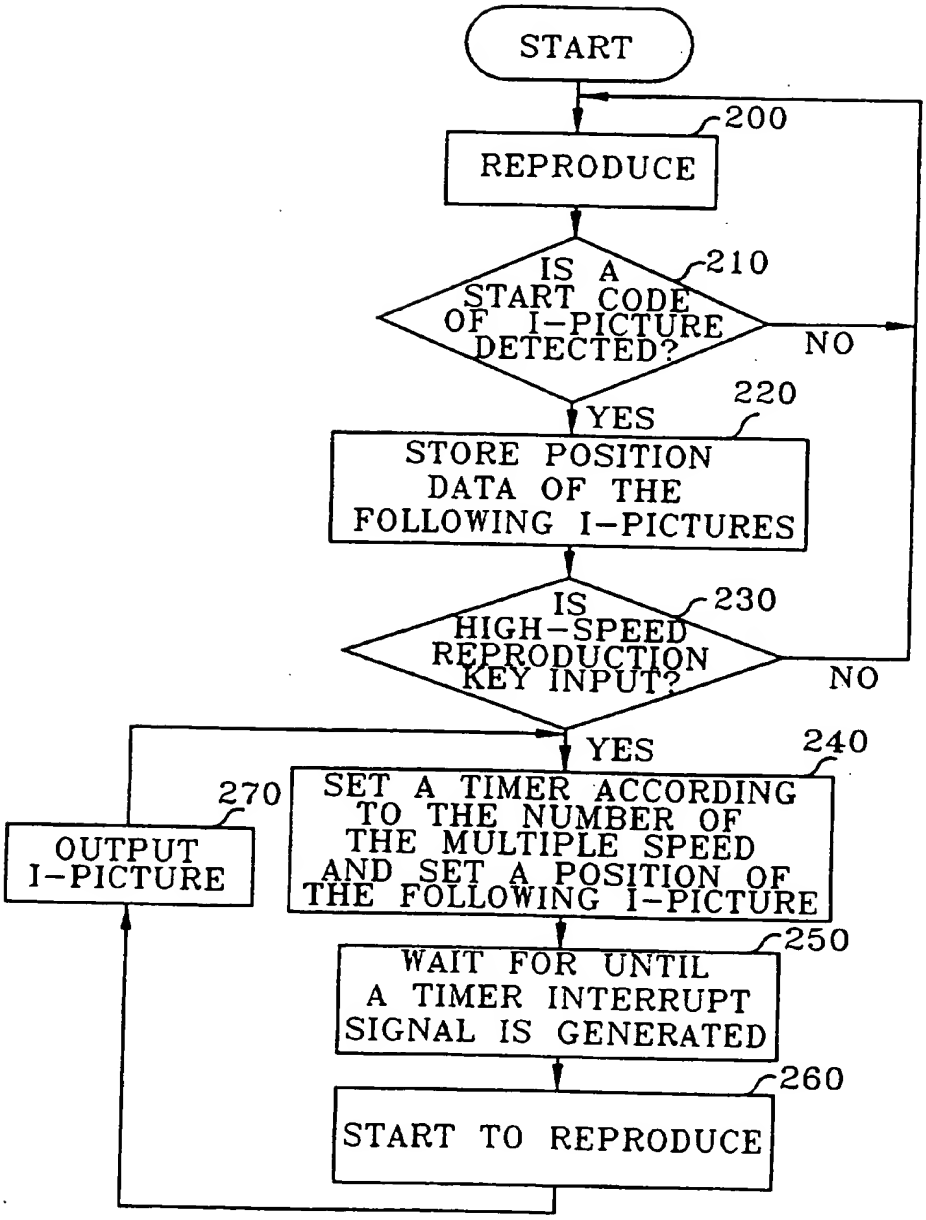

FIG. 7

| THE NUMBER OF MULTIPLE SPEED \ SELECT PERIOD OF I-PICTURE | 1(50) | 2(60) | 3(70) | 4(80) | 5(90) | 6(100) | 8(120) |
|---|---|---|---|---|---|---|---|
| 2 | 0.25 | 0.5 | 0.75 | 1.00 | 1.25 | 1.50 | 2.00 |
| 3 | 0.17 | 0.33 | 0.5 | 0.67 | 0.83 | 1.00 | 1.33 |
| 4 | 0.13 | 0.25 | 0.38 | 0.50 | 0.63 | 0.75 | 1.00 |
| 5 | 0.10 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.80 |
| 6 | 0.08 | 0.17 | 0.25 | 0.33 | 0.42 | 0.50 | 0.67 |
| 7 | 0.07 | 0.14 | 0.21 | 0.29 | 0.36 | 0.43 | 0.57 |
| 8 | 0.06 | 0.13 | 0.19 | 0.25 | 0.31 | 0.38 | 0.50 |
| 9 | 0.055 | 0.11 | 0.17 | 0.22 | 0.28 | 0.33 | 0.44 |
| 10 | 0.05 | 0.10 | 0.15 | 0.20 | 0.25 | 0.30 | 0.40 |
| 15 | 0.033 | 0.067 | 0.10 | 0.13 | 0.17 | 0.20 | 0.27 |
| 20 | – | 0.05 | 0.075 | 0.10 | 0.13 | 0.15 | 0.20 |
| 25 | – | 0.04 | 0.06 | 0.08 | 0.10 | 0.12 | 0.16 |
| 30 | – | – | 0.05 | 0.066 | 0.083 | 0.10 | 0.13 |

# DISK SYSTEM FOR HIGH-SPEED REPRODUCTION AND HIGH-SPEED REPRODUCTION APPARATUS AND METHOD FOR MOTION IMAGE DATA USING THE SAME

The present invention relates to a recording and reproduction system for moving image data using a disk, and more particularly, to a disk format for high-speed reproduction and a high-speed reproduction apparatus and method for moving image data using the same.

According to the MPEG (Moving Pictures Experts Group) standard, one GOP (group of pictures) is composed of an I-picture (intra-coded picture), P-pictures (predicted-coded pictures) and B-pictures (bidirectional-coded pictures). Among them, the I-picture is coded using its own image information only. The P-picture is coded using a previous I-picture or P-picture, and the B-picture is coded using previous and following I-pictures or P-pictures. Both the P-picture and the B-picture are coded using motion prediction techniques. Even when a moving picture is reproduced, the I-picture is decoded using its own information only, whereas the P-picture or the B-picture is decoded using previously decoded pictures by the motion compensation technique. When each picture of one GOP layer according to the MPEG is coded and decoded, the relationship between neighbouring pictures is shown in Figure 1A.

Referring to Figure 1B showing the relationship between the decoding sequence and the display sequence for each picture, an I-picture is decoded in one GOP and then a P-picture is decoded with reference to the decoded I-picture, and a B-picture is decoded with reference to the I-picture and the P-picture. When the decoded pictures

are displayed on a monitor, the B-picture is displayed in advance before the P-picture.

As can be seen from the above description, since the B-picture and the P-picture are coded and decoded dependant upon the previously coded and decoded other pictures, it is essential to use an I-picture to randomly access the data recorded on a disk and high-speed reproduce the data therefrom. An existing method for reading an I-picture for high-speed reproduction from a disk will be described below with reference to Figures 2 and 3.

Figure 2 shows a general apparatus for high-speed reproduction of image motion data according to the MPEG standard which is recorded on a disk. The Figure 2 apparatus includes a transmitter 10 for picking up the image motion data from the disk and outputting the picked-up data, a signal processor 12 for restoring the signal received from the transmitter 10 and an outputter 14 for outputting the restored signal. Also, the Figure 2 apparatus includes a controller 16 for controlling the above respective components.

Referring to Figure 3 showing a flow-chart for explaining the operation of the Figure 2 apparatus, the controller 16 responding to a user input using a reproduction key controls the transmitter 10 for picking up the data from a disk (not shown). The transmitter 10 responding to the controller 16 reads the motion image data from corresponding data reading positions on the disk and outputs the read data to the signal processor 12. The signal processor 12 restores the input data through a predetermined procedure (step 100). During restoring the motion image, the controller 16 judges whether a high-

speed reproduction key and the number of multiple speed for high-speed reproduction are input by a user (step 110). If it is judged that the high-speed reproduction key and the number of multiple speed have been input in step 110, the controller 16 determines a position to which a pickup (not shown) of the transmitter 10 will jump on the disk according to the number of multiple speed (step 120). For example, if the input number of multiple speed represents ten, the controller 16 performs a control operation in which the pickup of the transmitter 10 moves from a current position to a data recording position after 10 seconds. The transmitter 10 reads the data at the moved position and outputs the read data to the signal processor 12 (step 130). The signal processor 12 waits until the data read from the moved position, that is, the jumped position according to the 10 times speed, becomes an I-picture (step 140). If the I-picture is detected in step 140, the signal processor 12 restores the I-picture data and outputs the restored data to the outputter 14 (step 150). The outputter 14 outputs the restored data to a monitor (not shown). The controller 16 repetitively performs the procedures from step 120 to step 140 during high-speed reproduction mode.

Since such a conventional method jumps a disk position by a high-speed reproduction interval and repetitively performs a reproduction operation for a predetermined time from the position, I-pictures which exist on the disk are not read. Therefore, the faster the speed may be, the greater the number of the I-pictures are jumped.

As a result, the pictures displayed during the high-speed reproduction become more severely discontinuous as compared with pictures during normal reproduction, which

causes a viewer to have the difficulty in understanding the picture content.

Further, in cases where the Figure 2 apparatus is utilised to reproduce 60-minutes of pictures at four-times speed, the Figure 2 apparatus waits until the I-picture appears before reproducing the pictures. Accordingly, an actual reproduction time will become 15 minutes longer. Thus, the above-described high-speed reproduction apparatus cannot realize a proper high-speed reproduction operation.

With a view to solving or reducing the above problem, it is an aim of embodiments of the present invention to provide a disk containing position information representing recording positions of subsequent I-pictures in a recording area of a present I-picture, and to provide an apparatus which can realize a high-speed reproduction operation using a larger number of I-pictures from the disk within a given time according to a given selected multiple speed.

It is another aim of embodiments of the present invention to provide a method for realising high-speed reproduction by using a disk containing position information representing recording positions of subsequent I-pictures in a recording area of an I-picture.

According to a first aspect of the present invention, there is provided a disk system for reproducing moving image data at high speed according to the MPEG standard, the disk system comprising:

a disk on which a start code representing a start of an I-picture on a recording area of the I-picture,

position information representing positions of a predetermined number of successive I-pictures which are recorded after the current I-picture on the disk, and the I-picture data, are recorded; and

means for determining positions of the following I-pictures to be used for high-speed reproduction using the position information recorded on the disk, and reproducing the I-picture data recorded on corresponding positions of the disk according to the position information representing the positions of the determined following I-pictures, and repeating the determining and reproducing operations.

Preferably, said means comprises a means for moving to the positions of the following I-pictures to be reproduced based on the positions of the following I-pictures determined during the predetermined waiting time, and reproducing the I-picture of the corresponding position if the predetermined waiting time elapses.

Preferably, said means determines the positions of the following I-pictures to be reproduced in response to the selected multiple speed for high-speed reproduction.

Preferably, said means comprises:

a transmitter for reading data from said disk;

a signal processor for restoring data read from said transmitter;

a memory for storing the position information of successive I-pictures;

a timer for checking a set time; and

a controller for controlling said transmitter and said signal processor, by setting a time in the timer based on the selected multiple speed, moving to the position of the I-picture to then be restored using the position information stored in said memory, and restoring the I-picture data at a moved position if a signal notifying that the set time is reached is generated from said timer.

According to a second aspect of the present invention, there is provided a high-speed reproduction method for moving image data according to the MPEG standard recorded on a disk, the high-speed reproduction method comprising the steps of:

(a) reading a start coded representing a start of an I-picture on a recording area of the I-picture, position information representing positions of a predetermined number of successive I-pictures which are recorded after the current I-picture on the disk, and the I-picture data, from a recording area for the I-pictures of the disk;

(b) detecting and storing the position information of the I-pictures among the data read in step (a), and reproducing the current I-picture data; and

(c) finding a recording area of the following I-picture to be used for high-speed reproduction using the position information stored in step (b).

Preferably, said step (b) comprises the steps of:

(b1) detecting the start code of the I-picture among the read data; and

(b2) reading and storing the position information of the following I-pictures corresponding to the detected start code.

Preferably, said step (c) comprises the step of determining the positions of the following I-pictures for high-speed reproduction among the position information stored in step (b), based on the selected multiple speed for high-speed reproduction.

Said step (c) preferably comprises the steps of:

(c1) setting a waiting time according to the selected multiple speed for high-speed reproduction;

(c2) determining the positions of the following I-pictures to be used for high-speed reproduction based on the selected multiple speed; and

(c3) moving to the position of the following I-picture determined in step (c2) if the set waiting time is reached.

Said step (c3) preferably comprises the step of reading and storing the position information of the following I-pictures at the moved position.

According to a third aspect of the invention there is provided a system for the reproduction of moving image data at a high-speed according to the MPEG standard, the system comprising:

means for reading a start code, current I-picture data and position information relating to subsequent I-pictures from a disk;

means for reproducing the current I-picture data;

means for determining a position of a subsequent I-picture data to be used for high-speed reproduction in accordance with said position information and a given selected multiple speed; and

means for moving to the position of said subsequent I-picture.

According to a fourth aspect of the invention there is provided a method for the reproduction of moving image data at a high-speed according to the MPEG standard, the method comprising the steps of:

(i) reading a start code, current I-picture data and position information relating to subsequent I-pictures from a disk;

(ii) reproducing the current I-picture data;

(iii) determining a position of a subsequent I-picture data to be used for high-speed reproduction in accordance with said position information and a given selected multiple speed;

(iv) moving to the position of said subsequent I-picture; and

(v) repeating said steps (i) to (iv).

The invention includes a system or method in accordance with the third or fourth aspects respectively, further comprising any one or more features from the accompanying description, claims, abstract or Figures, in any combination.

For a better understanding of the invention, and to show how embodiments of the same may be carried into effect, reference will now be made, by way of example, to the accompanying diagrammatic drawings, in which:

Figure 1A is a view for explaining the relationship between neighbouring pictures when each picture of one GOP layer according to the MPEG is coded and decoded;

Figure 1B shows the relationship between the decoding sequence and the display sequence for each picture in one GOP layer;

Figure 2 is a block diagram of a conventional high-speed reproduction apparatus for moving image data;

Figure 3 is a flow-chart diagram for explaining the operation of the Figure 2 apparatus;

Figure 4 is a view showing a disk format for high-speed reproduction according to an embodiment of the present invention;

Figure 5 is a block diagram of a high-speed reproduction apparatus for moving image data using a disk according to an embodiment of the present invention;

Figure 6 is a flow-chart diagram for explaining the operation of the Figure 5 apparatus; and

Figure 7 is a table showing a waiting time before the I-picture is reproduced according to embodiments of the present invention.

Preferred embodiments of the present invention will be described in detail with reference to the accompanying drawings Figures 4 through 7.

Figure 4 shows a disk format for high-speed reproduction according to an embodiment of the present invention and illustrates a detailed recording area of the I-picture. A start code of the I-picture is recorded in a recording area of an n-th I-picture of the disk. Position information representing the positions on the disk on which eight successive I-pictures are recorded among the I-pictures recorded after the n-th I-picture is recorded following the start code. Here, the reason for recording eight kinds of the position information will be described later on. The n-th I-picture data is recorded following the position information of the I-pictures.

Figure 5 is a block diagram of a high-speed reproduction apparatus for high-speed reproducing moving image data according to the present invention, from the disk having a disk format shown in Figure 4. The blocks of Figure 5 which correspond to those of Figure 2 have the same reference numerals.

The Figure 5 apparatus further includes a memory 18 for storing the position information of the I-pictures read from the disk (not shown). Also, the Figure 5 apparatus includes a timer 20 for checking a time set in the controller 16 and generating an interrupt signal if it reaches the set time.

The operation of the Figure 5 apparatus having the above construction will be described below in more detail with reference to Figures 6 and 7.

If a reproduction key is input by a user, the controller 26 controls the Figure 5 apparatus to perform a reproduction operation (step 200). The transmitter 10 reads the data from the disk and outputs the read data to the signal processor 12. The signal processor 12 judges whether the data input from the transmitter 10 contains the start code of the I-picture (step 210). If the I-picture start code is detected in step 210, the controller 26 reads position information of the following I-pictures contained in the following side of the I-picture start code and stores the read position information in the memory 18 (step 220). Thereafter, the controller 26 judges whether the high-speed reproduction key is input (step 230). If the high-speed reproduction key is input, the controller 26 sets a predetermined waiting time to the timer on the basis of the number of multiple speed input together with the high-speed reproduction key.

A table showing a set waiting time is shown in Figure 7. The horizontal axis in Figure 7 represents a select period of a possible I-picture for high-speed reproduction, and the vertical axis therein represents the number of multiple speed. In the Figure 7, the table is made on the assumption that 50ms is required for a data processing time to access an initial one I-picture in the transmitter 10, and 10ms is further required every time the number of jumped I-picture increases by one. The data processing time in the transmitter 10 is shown in parentheses on the horizontal axis of the table, whose unit is mili-seconds. Also, in the table, the figures in the thicker solid boxes represent waiting times which can

best realize the corresponding number of multiple speed with respect to the data processing times of the system. Here, the unit of the waiting time is a second. For example, referring to Figure 7, if data is reproduced at fifteen times speed and one I-picture is reproduced every two I-pictures having a waiting time of 0.067 seconds, it can be seen that the I-pictures can be reproduced at an exact fifteen times speed while having the maximum number of I-pictures. Since a maximum of 30 times reproduction speed is possible according to Figure 7, eight kinds of the position information of the following I-pictures has been recorded as shown in Figure 4.

When the Figure 5 apparatus operates at ten times speed for high-speed reproduced and 60ms is required for processing data in the transmitter 10, the controller 26 sets the timer 20 to 0.1 seconds according to the table of Figure 7. Also, in order to read one I-picture every two I-pictures from the disk, the position information of the (n+2)-th I-picture which is position information of the I-picture to then be restored is read from the memory 18. The controller 26 moves the pickup of the transmitter 10 to the position of the I-picture which has been thirdly recorded from the current position according to the information read from the memory 18 (step 240). Then, the position information of the following I-pictures is read from the moved position and the read information is stored again in the memory 18. The controller 26 becomes a waiting state until an interrupt signal is generated from the timer 20 (step 250). If the timer 20 generates an interrupt signal at the time when the waiting time set by the controller 26 becomes 0.1 seconds, the controller 26 starts to operate and controls the transmitter 10 and the signal processor 12 so that the I-picture data is read at the current position of the disk and the read data is

restored (steps 260 and 270). The outputter 14 receives the restored data from the signal processor 12 and outputs the received data under control of the controller 26. The controller 26 repetitively performs the procedures from step 240 to step 270 during the high-speed reproduction mode.

Since a general one GOP is composed of data having an amount of 0.5 seconds (15 frames in case of the NTSC system and 12.5 frames in case of the PAL system), the interval between the I-pictures in which one I-picture exists every one GOP becomes 0.5 seconds. In this case, if the moving image data is reproduced at 10 times speed using the conventional method, a total of 20 I-pictures become lost for 10 seconds. However, since one I-picture is reproduced every two I-pictures in the present invention, only 10 I-pictures become lost for 10 seconds. Also, since about one second is required for processing data having an amount of 10 seconds even in the reproduction time, an exact 10 times speed reproduction can be realized.

As described above, embodiments of the present invention use a larger amount of image information within a given time according to a given multiple speed in order to realize a high-speed reproduction operation so that a more natural image can be displayed.

While only certain embodiments of the invention have been specifically described herein, it will be apparent that numerous modifications may be made thereto without departing from the scope of the invention.

The reader's attention is directed to all papers and documents which are filed concurrently with or previous to

this specification in connection with this application and which are open to public inspection with this specification, and the contents of all such papers and documents are incorporated herein by reference.

All of the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive.

Each feature disclosed in this specification (including any accompanying claims, abstract and drawings), may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

The invention is not restricted to the details of the foregoing embodiment(s). The invention extends to any novel one, or any novel combination, of the features disclosed in this specification (including any accompanying claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed.

**CLAIMS**

1. A disk system for reproducing moving image data at high speed according to the MPEG standard, the disk system comprising:

a disk on which a start code representing a start of an I-picture on a recording area of the I-picture, position information representing positions of a predetermined number of successive I-pictures which are recorded after the current I-picture on the disk, and the I-picture data, are recorded; and

means for determining positions of the following I-pictures to be used for high-speed reproduction using the position information recorded on the disk, and reproducing the I-picture data recorded on corresponding positions of the disk according to the position information representing the positions of the determined following I-pictures, and repeating the determining and reproducing operations.

2. The disk system according to claim 1, wherein said means comprises a means for moving to the positions of the following I-pictures to be reproduced based on the positions of the following I-pictures determined during the predetermined waiting time, and reproducing the I-picture of the corresponding position if the predetermined waiting time elapses.

3. The disk system according to claim 1 or 2, wherein said means determines the positions of the following I-pictures to be reproduced in response to the selected multiple speed for high-speed reproduction.

4. The disk system according to claim 3, wherein said means comprises:

a transmitter for reading data from said disk;

a signal processor for restoring data read from said transmitter;

a memory for storing the position information of successive I-pictures;

a timer for checking a set time; and

a controller for controlling said transmitter and said signal processor, by setting a time in the timer based on the selected multiple speed, moving to the position of the I-picture to then be restored using the position information stored in said memory, and restoring the I-picture data at a moved position if a signal notifying that the set time is reached is generated from said timer.

5. A high-speed reproduction method for moving image data according to the MPEG standard recorded on a disk, the high-speed reproduction method comprising the steps of:

(a) reading a start code representing a start of an I-picture on a recording area of the I-picture, position information representing positions of a predetermined number of successive I-pictures which are recorded after the current I-picture on the disk, and the I-picture data, from a recording area of the I-pictures of the disk;

(b) detecting and storing the position information of the I-pictures among the data read in step (a), and reproducing the current I-picture data; and

(c) finding a recording area of the following I-picture to be used for high-speed reproduction using the position information stored in step (b).

6. The high-speed reproduction method according to claim 5, wherein said step (b) comprises the steps of:

(b1) detecting the start code of the I-picture among the read data; and

(b2) reading and storing the position information of the following I-pictures corresponding to the detected start code.

7. The high-speed reproduction method according to claim 5 or 6, wherein said step (c) comprises the step of determining the positions of the following I-pictures for high-speed reproduction among the position information stored in step (b), based on the selected multiple speed for high-speed reproduction.

8. The high-speed reproduction method according to claim 5, 6 or 7, wherein said step (c) comprises the steps of:

(c1) setting a waiting time according to the selected multiple speed for high-speed reproduction;

(c2) determining the positions of the following I-pictures to be used for high-speed reproduction based on the selected multiple speed; and

(c3) moving to the position of the following I-picture determined in step (c2) if the set waiting time is reached.

9. The high-speed reproduction method according to claim 8, wherein said step (c3) comprises the step of reading and storing the position information of the following I-pictures at the moved position.

10. A system for the reproduction of moving image data at a high-speed according to the MPEG standard, the system comprising:

means for reading a start code, current I-picture data and position information relating to subsequent I-pictures from a disk;

means for reproducing the current I-picture data;

means for determining a position of a subsequent I-picture data to be used for high-speed reproduction in accordance with said position information and a given selected multiple speed; and

means for moving to the position of said subsequent I-picture.

11. A method for the reproduction of moving image data at a high-speed according to the MPEG standard, the method comprising the steps of:

(i) reading a start code, current I-picture data and position information relating to subsequent I-pictures from a disk;

(ii) reproducing the current I-picture data;

(iii) determining a position of a subsequent I-picture data to be used for high-speed reproduction in accordance with said position information and a given selected multiple speed; and

(iv) moving to the position of said subsequent I-picture; and

(v) repeating said steps (i) to (iv).

12. A system according to claim 10 or a method according to claim 11, further comprising one or more features from the accompanying description, claims, abstract or drawings, in any combination.

13. A system substantially as herein described, with reference to Figures 4 to 7.

14. A high-speed reproduction method substantially as herein described with reference to Figures 4 to 7.

The Patent Office

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| | | | |
|---|---|---|---|
| **Application No:** | GB 9625687.0 | **Examiner:** | John Coules |
| **Claims searched:** | 1-14 | **Date of search:** | 4 March 1997 |

## Patents Act 1977
## Search Report under Section 17

**Databases searched:**

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): H4F FKA,FEHX

Int Cl (Ed.6): H04N 5/76,5/781,5/783,5/915,5/926

Other: Online: WPI,INSPEC

**Documents considered to be relevant:**

| Category | Identity of document and relevant passage | Relevant to claims |
|---|---|---|
| | None | |

| | | | |
|---|---|---|---|
| X | Document indicating lack of novelty or inventive step | A | Document indicating technological background and/or state of the art. |
| Y | Document indicating lack of inventive step if combined with one or more other documents of same category. | P | Document published on or after the declared priority date but before the filing date of this invention. |
| & | Member of the same patent family | E | Patent document published on or after, but with priority date earlier than, the filing date of this application. |